

299-W14-03 (A7329) Log Data Report

Borehole Information:

Borehole: 299-W14-03 (A7329)		Site: 216-T-28 Crib			
Coordinates (WA State Plane)		GWL (ft)¹: 228.4	GWL Date: 08/09/04		
North	East	Drill Date	TOC² Elevation	Total Depth (ft)	Type
136342.965 m	566940.409 m	12/61	675.17 ft	270	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	3.6	6 5/8	6	5/16	3.6	157
Welded Steel	0.0	8	unknown	unknown	0	270

Borehole Notes:

The logging engineer used a steel tape to measure the 6-in. casing. The 8-in. casing was not visible at the ground surface and could not be measured. The presence of the 8-in. casing is described in Ledgerwood (1993). All logging measurements are referenced to top of the 6-in. casing. Before the borehole was logged a swab was acquired of the interior of the borehole. No contamination was detected on the swab.

Ledgerwood (1993) indicated the 6-in. casing was set inside the 8-in. casing on a packer to 157 ft. The 8-in. casing was perforated from 0-20 ft and from 80-150 ft, and the annulus between the 6-in. and 8-in. casing was grouted. The 8-in. casing was also perforated from 208 to 268 ft. Ledgerwood indicated the groundwater level was at 220 and 200 ft in December 1961 and March 1990, respectively; the current level from TOC is approximately 228.4 ft.

Logging Equipment Information:

Logging System:	Gamma 4E	Type:	SGLS (70%) 34TP40587A
Calibration Date:	05/04	Calibration Reference:	DOE-EM/GJ692-2004
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 1C	Type:	HRLS planar 39A314
Calibration Date:	05/04	Calibration Reference:	DOE-EM/GJ713-2004
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	3		
Date	08/09/04	08/10/04	08/10/04		
Logging Engineer	Spatz	Spatz	Spatz		

Log Run	1	2 Repeat	3		
Start Depth (ft)	227.0	140.0	83.0		
Finish Depth (ft)	82.0	117.0	4.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	1.0		
ft/min	N/A ³	N/A	N/A		
Pre-Verification	DE191CAB	De201CAB	DE201CAB		
Start File	DE191000	DE201000	DE201024		
Finish File	DE191145	DE201023	DE201103		
Post-Verification	DE191CAA	DE211CAA	DE211CAA		
Depth Return Error (in.)	-2	N/A	-1		
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.		

High Rate Logging System (HRLS) Log Run Information:

Log Run	4	5	6	7	8
Date	08/19/04	08/19/04	08/19/04	08/19/04	08/19/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	33.0	30.0	13.0	12.0	26.0
Finish Depth (ft)	30.0	11.0	13.0	11.0	21.0
Count Time (sec)	300	100	10	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AC108CAB	AC108CAB	AC108CAB	AC108CAB	AC108CAB
Start File	AC108000	AC108004	AC108024	AC108025	AC108027
Finish File	AC108003	AC108023	AC108024	AC108026	AC108032
Post-Verification	AC108CAA	AC108CAA	AC108CAA	AC108CAA	AC108CAA
Depth Return Error (in.)	N/A	N/A	N/A	N/A	0
Comments	No fine-gain adjustment.	No fine-gain adjustment. File -021 at 13 ft was unusable.	No fine-gain adjustment. 13-ft interval was repeated.	No fine-gain adjustment.	No fine-gain adjustment.

Log Run	9	10 Repeat			
Date	08/19/04	08/19/04			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	20.0	18.0			
Finish Depth (ft)	13.0	15.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	Y (internal)	Y (internal)			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AC108CAB	AC108CAB			
Start File	AC108033	AC108041			
Finish File	AC108040	AC108044			
Post-Verification	AC108CAA	AC108CAA			
Depth Return Error (in.)	N/A	N/A			

Log Run	9	10 Repeat			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Logging Operation Notes:

Logging was performed with a centralizer installed on the sondes except for log run 1. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K , ^{238}U , and ^{232}Th) verifier with serial number 118.

High rate logging was performed from 11 to 33 ft. An internal tungsten shield was used from 13 to 20 ft (log runs 9 and 10) in the depth interval of highest gamma activity. The pre- and post-verification measurements were acquired in the CS-137 verifier, SN 1013.

Maximum logging depth was 227 ft, approximately 1 ft above groundwater.

Analysis Notes:

Analyst:	Henwood	Date:	09/17/04	Reference:	GJO-HGLP 1.6.3, Rev. 0
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SGLS and HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. All of the verification spectra were within the acceptance criteria. Examinations of spectra indicate that the detectors functioned normally during logging, and the spectra are accepted.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations for SGLS and HRLS spectra were calculated in EXCEL (source files: G4EJul04.xls and G1CMay04.xls, respectively). A combined casing thickness of 0.6345 in. (0.3125 in. + 0.322 in. for the 6- and 8-in. casings, respectively) was applied to the data from 0 to 157 ft. Below 158 ft a 0.322-in.-thick casing correction was applied. Dead time corrections are applied to the SGLS data where dead time exceeds 4.7 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. Where dead time for the HRLS exceeds 40 percent, data are acquired with an internal shield on the HRLS. No water corrections were required.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K , ^{238}U , and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

A comparison plot of the Westinghouse Hanford Company Radionuclide Logging System (RLS) data acquired in 1992 with the current SGLS data is included. Historical gross gamma logging plots have been copied from Fecht et al. (1977) and digitized. These logs are plotted with the current SGLS total gamma log.

Results and Interpretations:

^{137}Cs , ^{60}Co , ^{154}Eu , ^{152}Eu , and ^{126}Sn were the man-made radionuclides detected in this borehole. ^{137}Cs was detected throughout the borehole from the ground surface to total depth (227 ft). A relatively high concentration interval is measured between 10 and 42 ft with a maximum concentration of approximately 3.6 E06 pCi/g at 16 ft. Below 60 ft to total depth ^{137}Cs is measured almost continuously at concentrations less than 1 pCi/g. An exception is an interval from 151 to 161 ft with a maximum concentration of approximately 10 pCi/g. Boreholes in the area have a sand pack emplaced near this depth (Ledgerwood 1993).

^{60}Co was detected between 30 and 98 ft, 157 and 176 ft, and between 205 ft and total depth. The maximum concentration was measured at approximately 2 pCi/g at 40 ft. It is likely ^{60}Co exists in the high gamma activity zone between 10 and 30 ft. The MDL for ^{60}Co is significantly increased in the high activity zone such that it may not be detected.

^{154}Eu was detected between 31 and 121 ft at concentrations ranging from 0.3 to 95 pCi/g. The maximum concentration was measured at approximately 95 pCi/g at 100 ft. It is likely ^{154}Eu exists in the high gamma activity zone between 10 and 30 ft. The MDL for ^{154}Eu is significantly increased in the high activity zone such that it may not be detected.

^{152}Eu was detected at similar depth locations as ^{154}Eu but not continuously. Concentrations ranged from 0.6 to 11 pCi/g; the maximum concentration was approximately 11 pCi/g at 81 ft. ^{152}Eu is generally expected to co-exist with ^{154}Eu .

^{126}Sn is measured by the 695-keV gamma-ray emission from ^{126}Sb . ^{126}Sn was detected between 30 and 42 ft at concentrations ranging from 0.6 to 11 pCi/g; the maximum concentration was measured at 32 ft in depth. This radionuclide likely also exists in the high rate interval.

A comparison plot of RLS data acquired in 1992 with the current SGLS data is included. The RLS data were decayed to the date of the SGLS log data. Differences in calibration methodology or casing corrections appear to have resulted in a slight offset in calculated concentrations. However, the profiles of the sets of log data are similar, suggesting stability of contaminants since 1992.

Plots of historical gross gamma logs acquired in this borehole in 1963 and 1976 (before borehole remediation activities in 1983) are included (Fecht et al. 1977). Depth initiation problems or digitizing efforts appear to have resulted in depth discrepancies and were adjusted 3 ft downward. The earliest log data acquired in 04/29/63 indicates high gamma activity such that the detector was saturated from the ground surface to approximately 112 ft. Contaminants in this interval that were detected by the SGLS in 2004, include ^{137}Cs , ^{60}Co , ^{154}Eu , ^{152}Eu , and ^{126}Sn . Background levels of gamma activity in 1963 appear to begin at approximately 150 ft.

In 1976 elevated activity appears to exist at the same depth interval as in 1963, although decay of radionuclides is apparent. An interval from 205 to 230 ft indicates elevated activity relative to 1963. Current SGLS data show ^{60}Co and ^{137}Cs at this depth interval. Groundwater is reported in Ledgerwood (1993) at 220 ft in 1961 and 200 ft in 1990. WIDS reports: "Ritter (1966) states that a breakthrough of radioactive strontium and cesium to the groundwater beneath the crib occurred in 1965." The contamination observed at this depth may be residual left from the contaminant breakthrough in 1965.

The 1976 profile is similar to the current total gamma profile. One exception is the interval from 150 to 160 ft, where ^{137}Cs and slightly elevated total gamma are measured by the SGLS but the historical profiles suggest no elevated activity. This interval is associated with sandpack emplaced in 1983. It is not known why the sandpack would result in an apparent increase in ^{137}Cs concentrations.

The ^{40}K and ^{232}Th logs show some variations in concentrations, suggesting lithology changes that may be correlated with adjacent boreholes. Caution should be used when interpreting the data from the ground surface to 157 ft where grout is known to have been emplaced.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural and man-made radionuclides.

References:

Fecht, K.R., G.V. Last, and K.R. Price, 1977. *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*, ARH-ST-156, Atlantic Richfield Hanford Company, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-West Resource Protection Wells*, WHC-SD-ER-TI-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

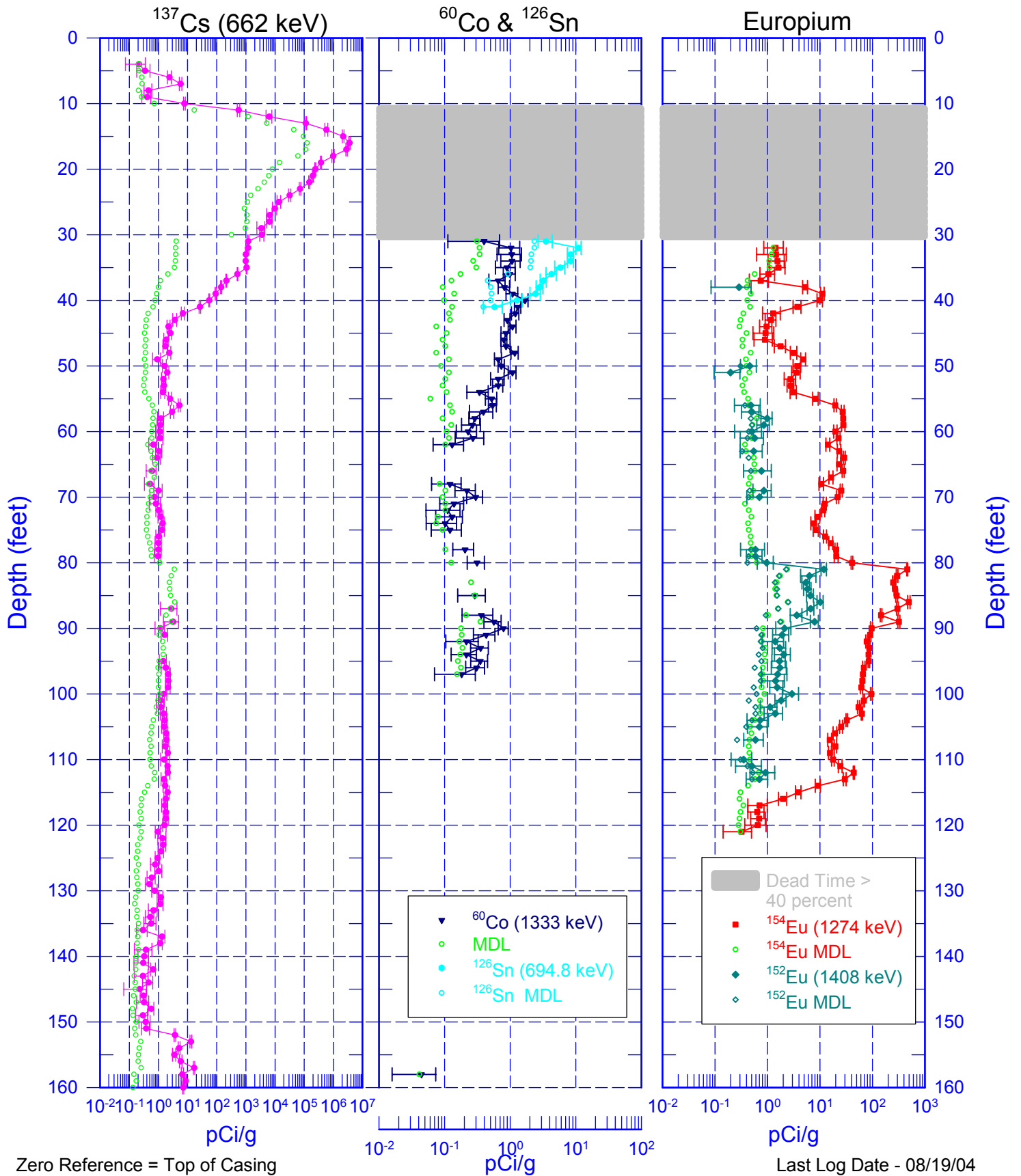
¹ GWL – groundwater level

² TOC – top of casing

³ N/A – not applicable

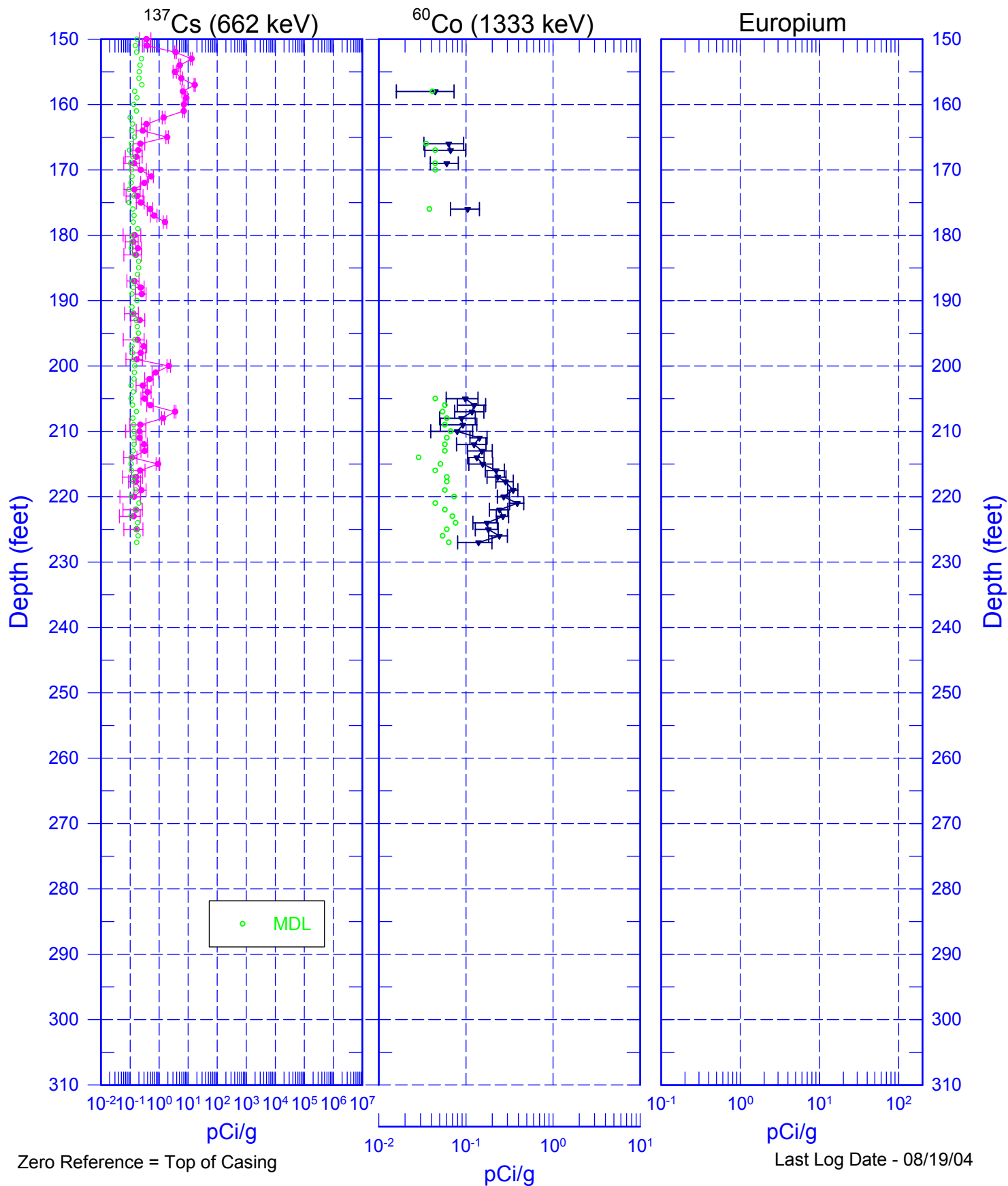
299-W14-03 (A7329)

Man-Made Radionuclides



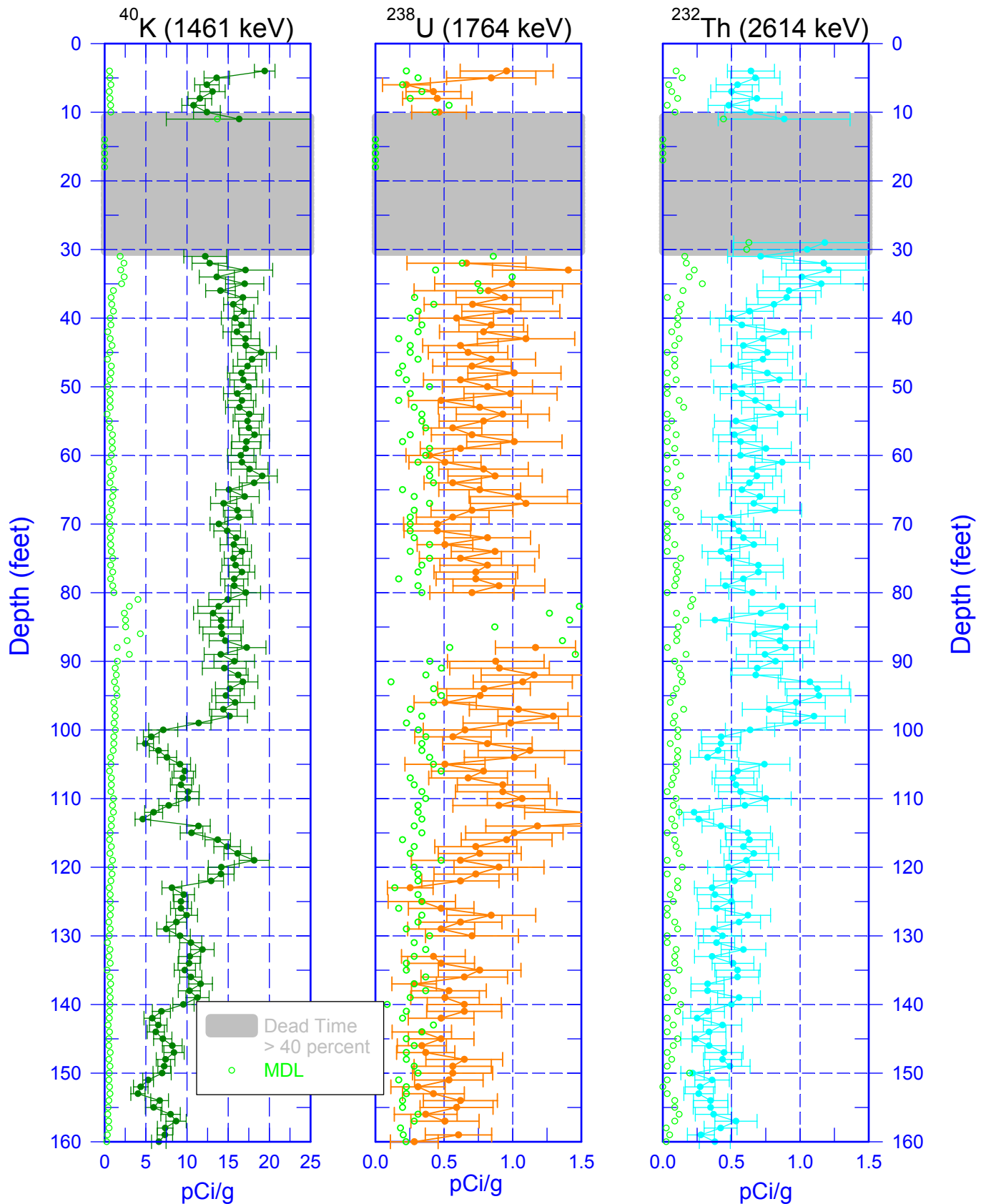
299-W14-03 (A7329)

Man-Made Radionuclides



299-W14-03 (A7329)

Natural Gamma Logs

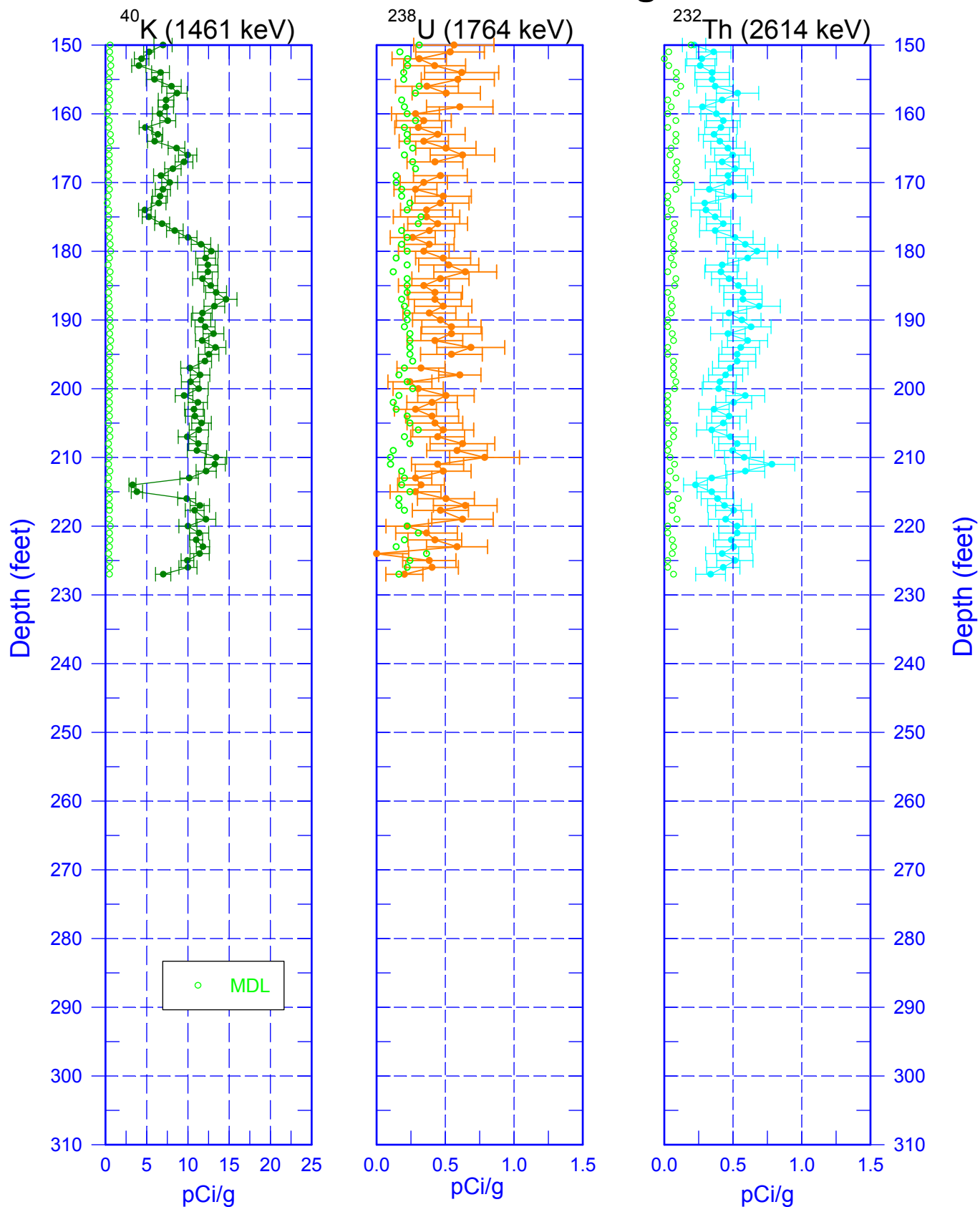


Zero Reference = Top of Casing

Last Log Date - 08/19/04

299-W14-03 (A7329)

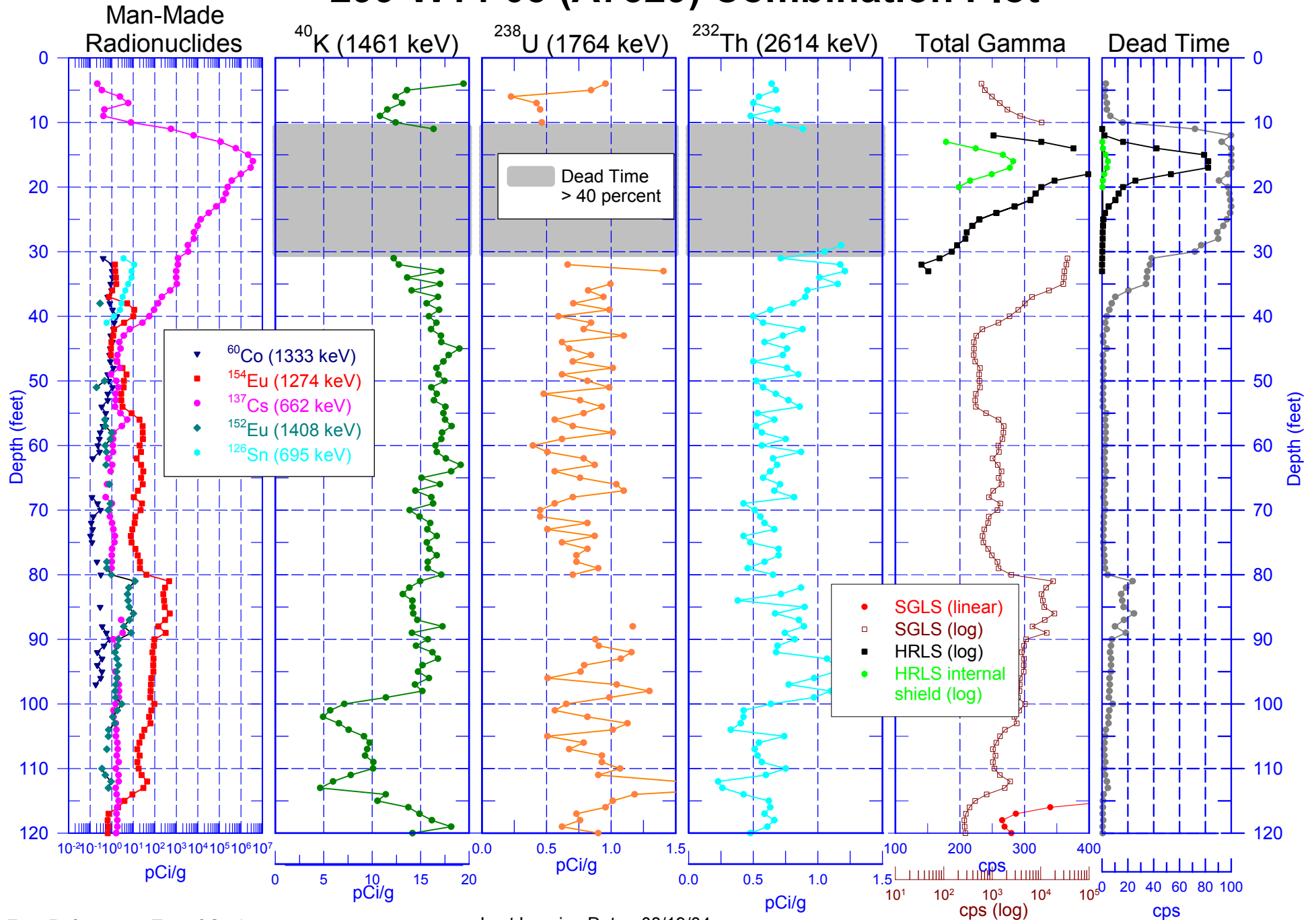
Natural Gamma Logs



Zero Reference = Top of Casing

Last Log Date - 08/19/04

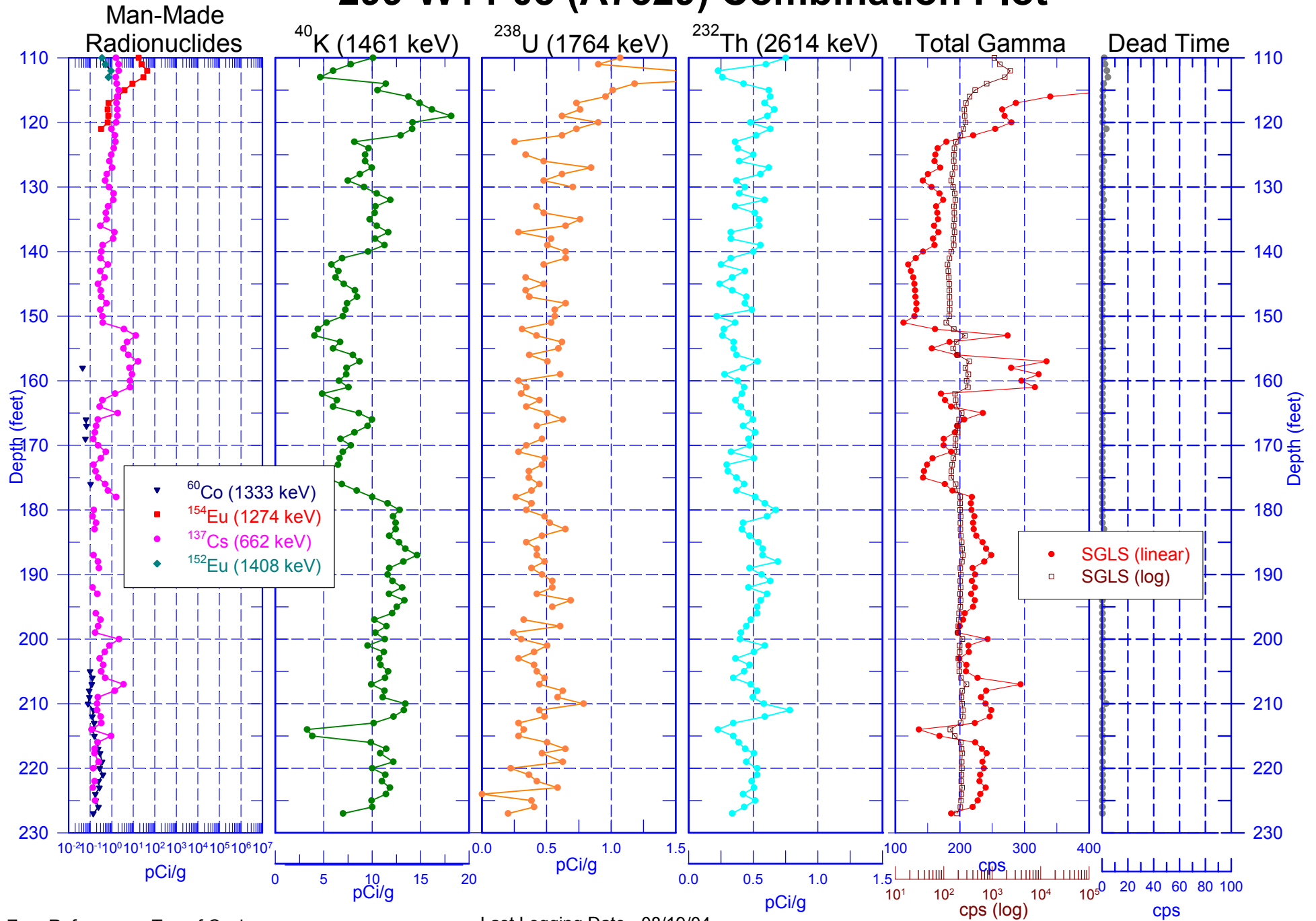
299-W14-03 (A7329) Combination Plot



Zero Reference = Top of Casing

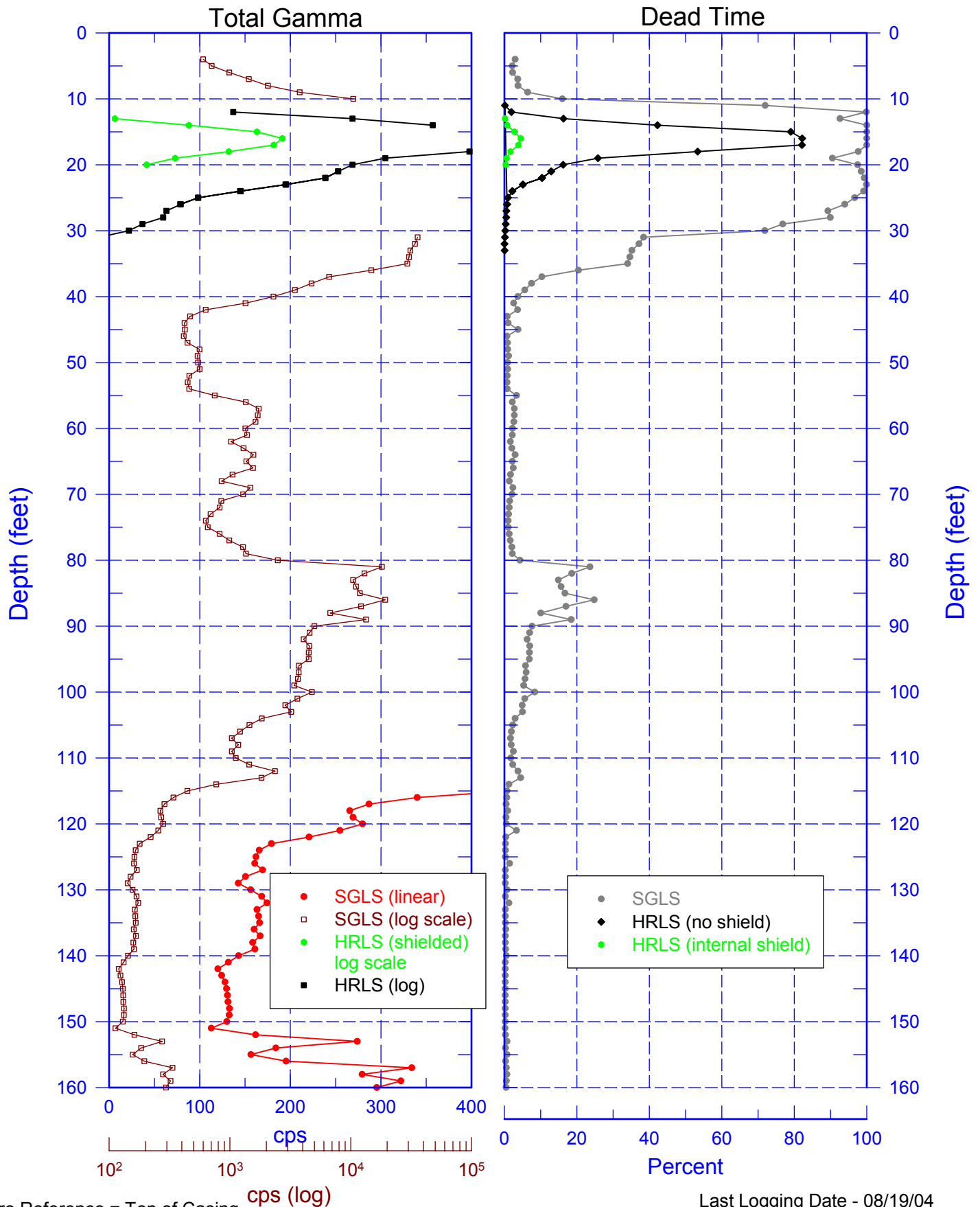
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299-W14-03 (A7329) Combination Plot



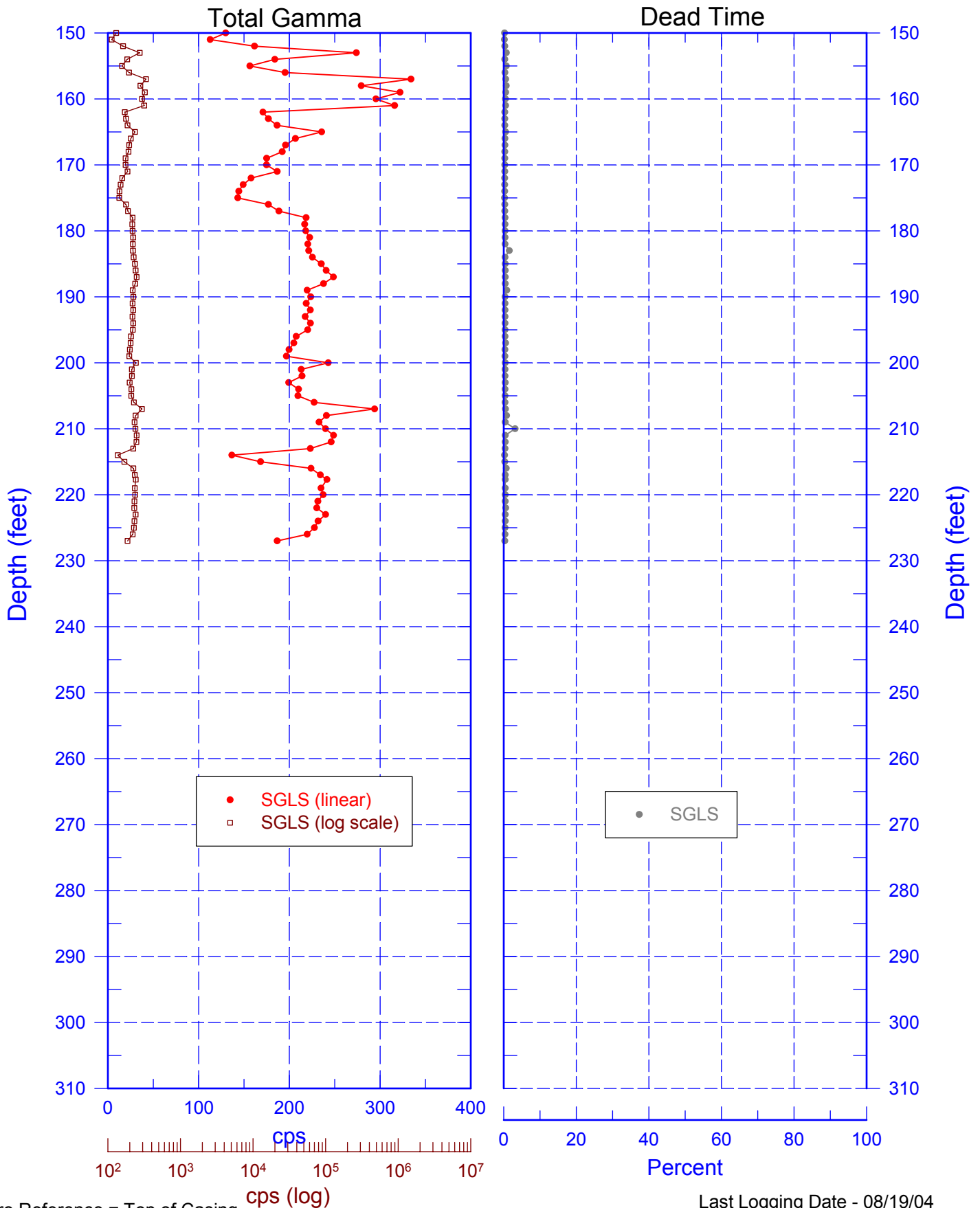
299-W14-03 (A7329)

Total Gamma & Dead Time



299-W14-03 (A7329)

Total Gamma & Dead Time

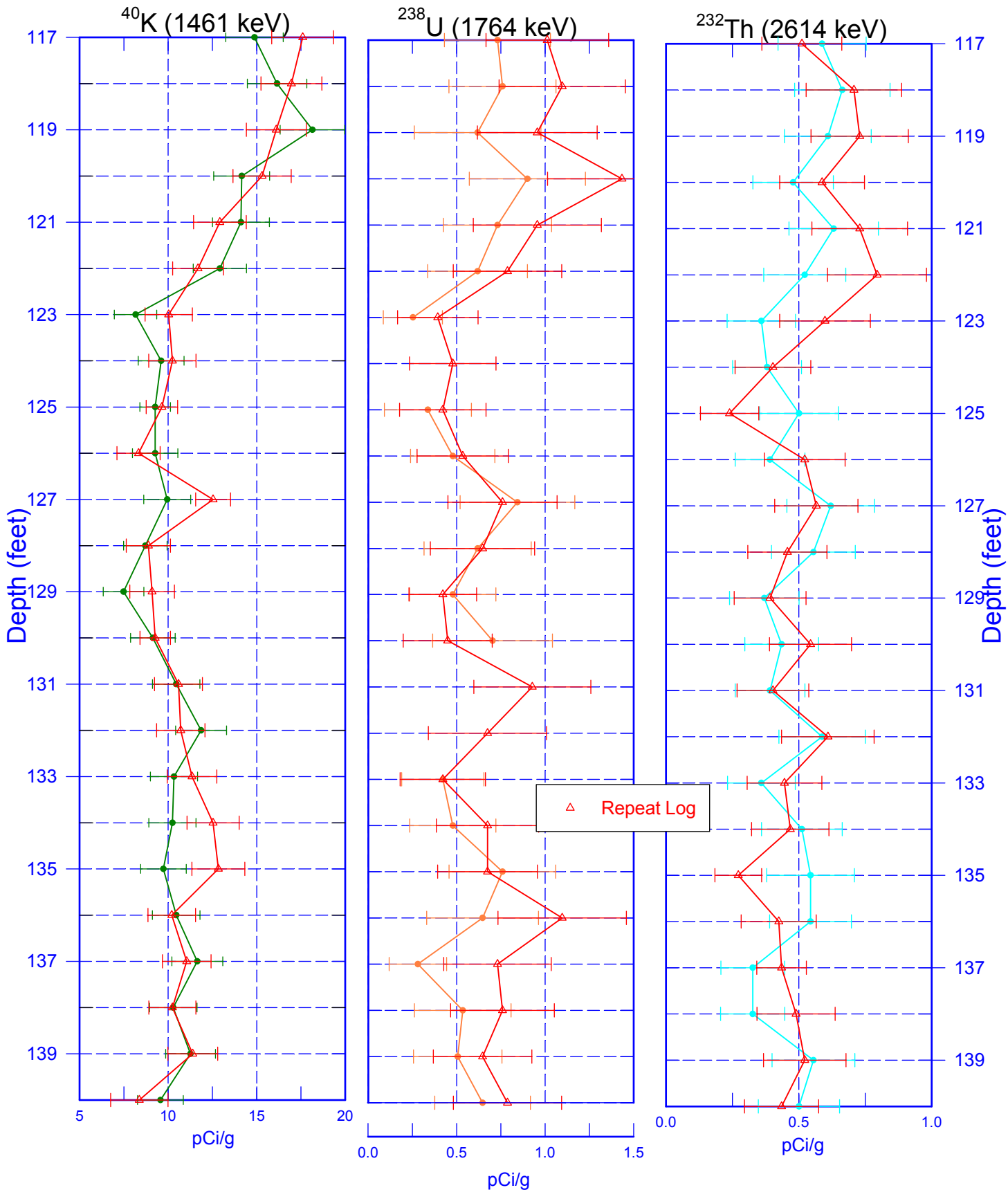


Zero Reference = Top of Casing

Last Logging Date - 08/19/04

299-W14-03 (A7329)

Repeat Section of Natural Gamma Logs

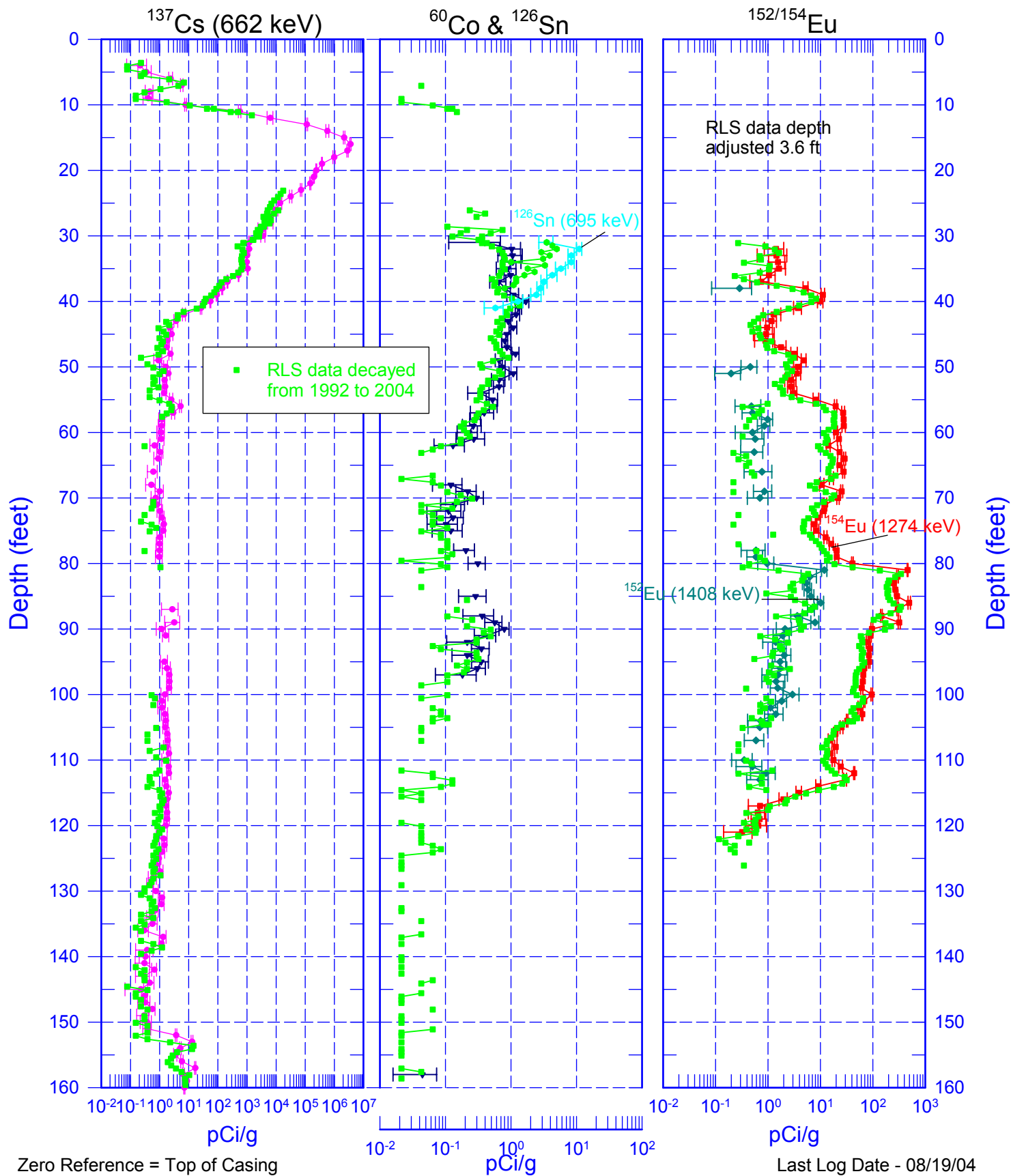


Zero Reference = Top of Casing

Last Log Date - 08/19/04

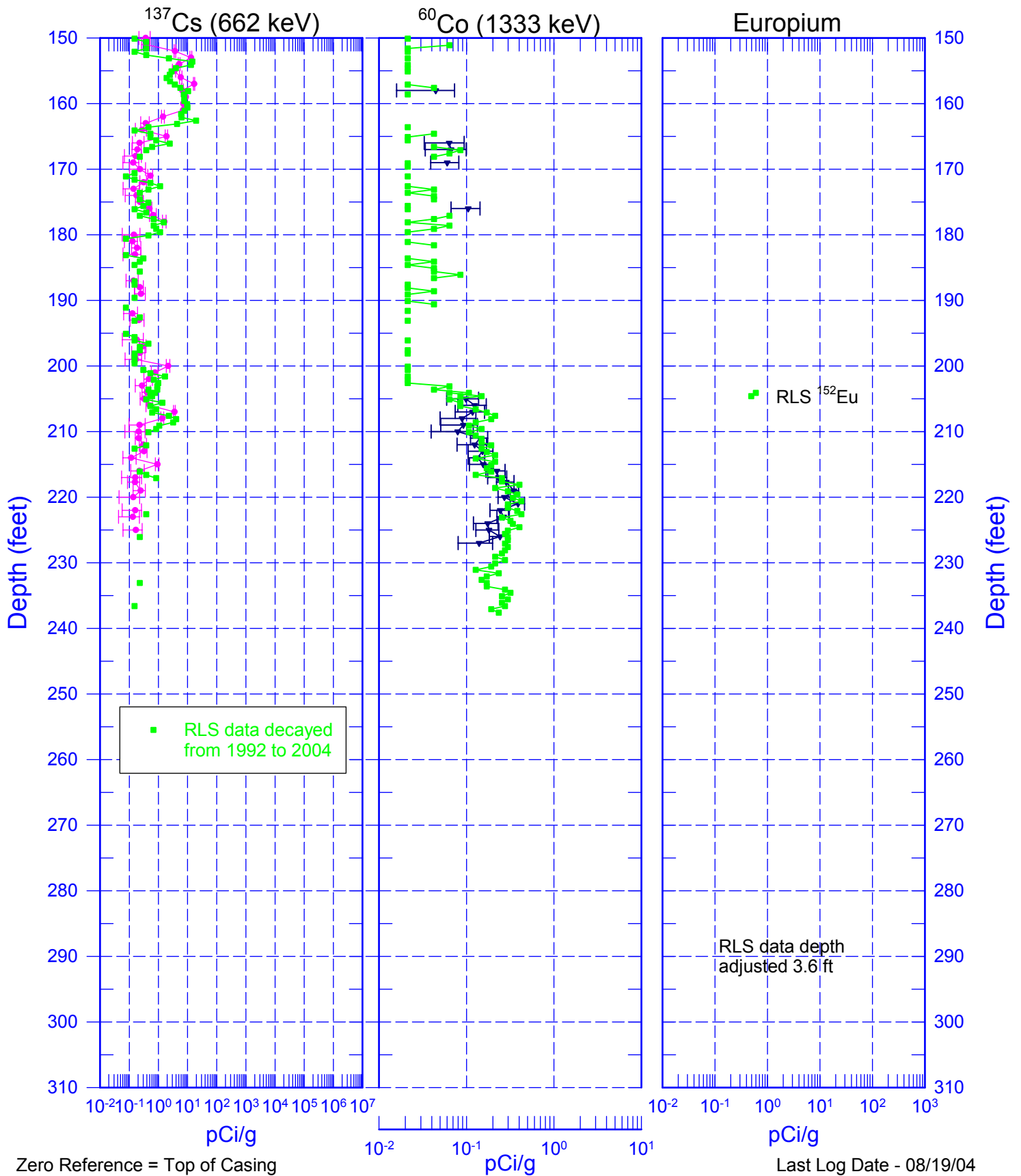
299-W14-03 (A7329)

Man-Made Radionuclide Comparison



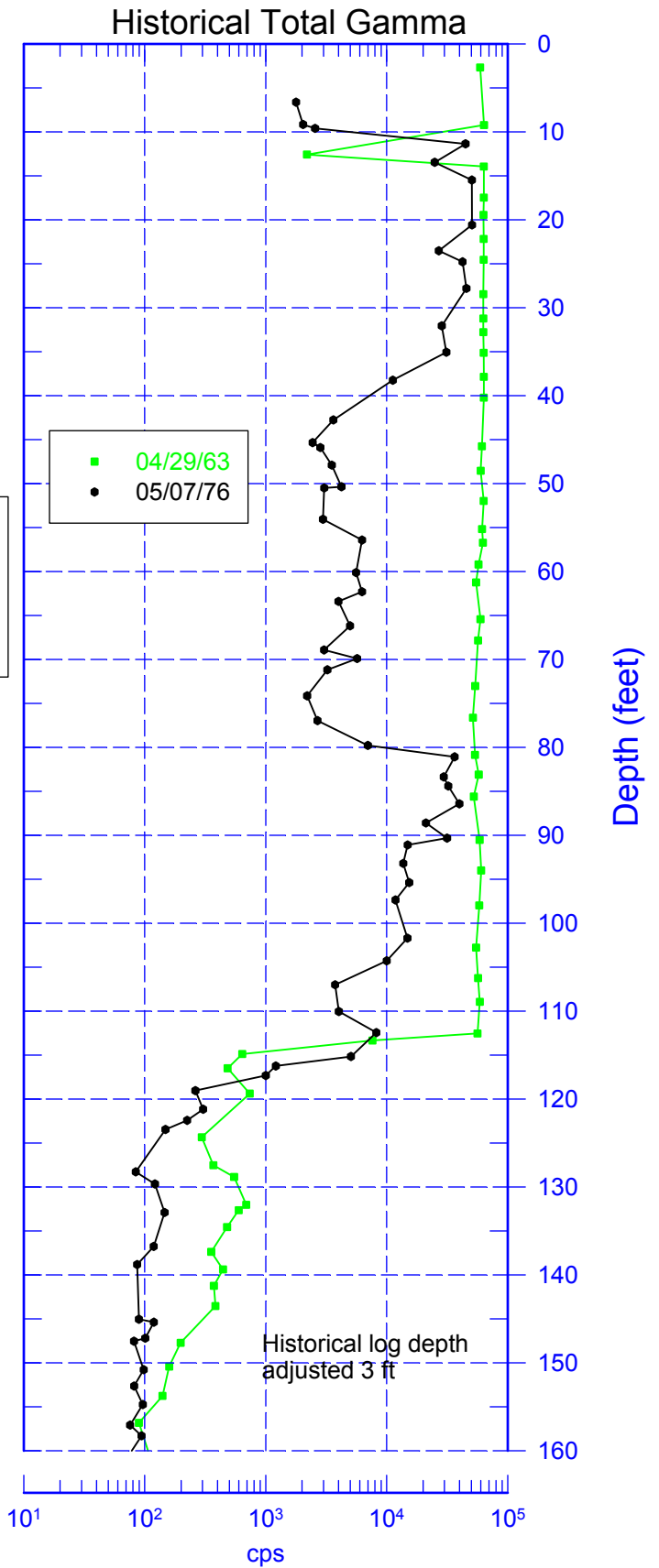
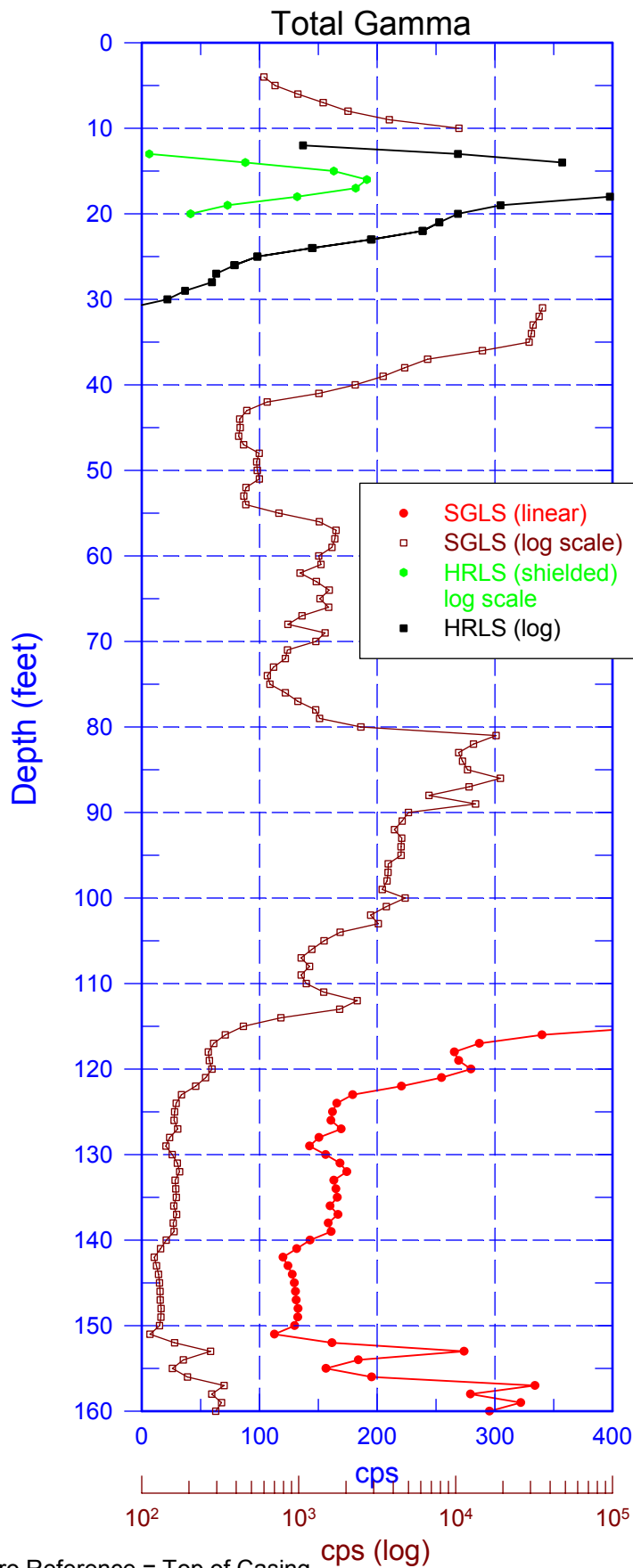
299-W14-03 (A7329)

Man-Made Radionuclide Comparison



299-W14-03 (A7329)

Total Gamma

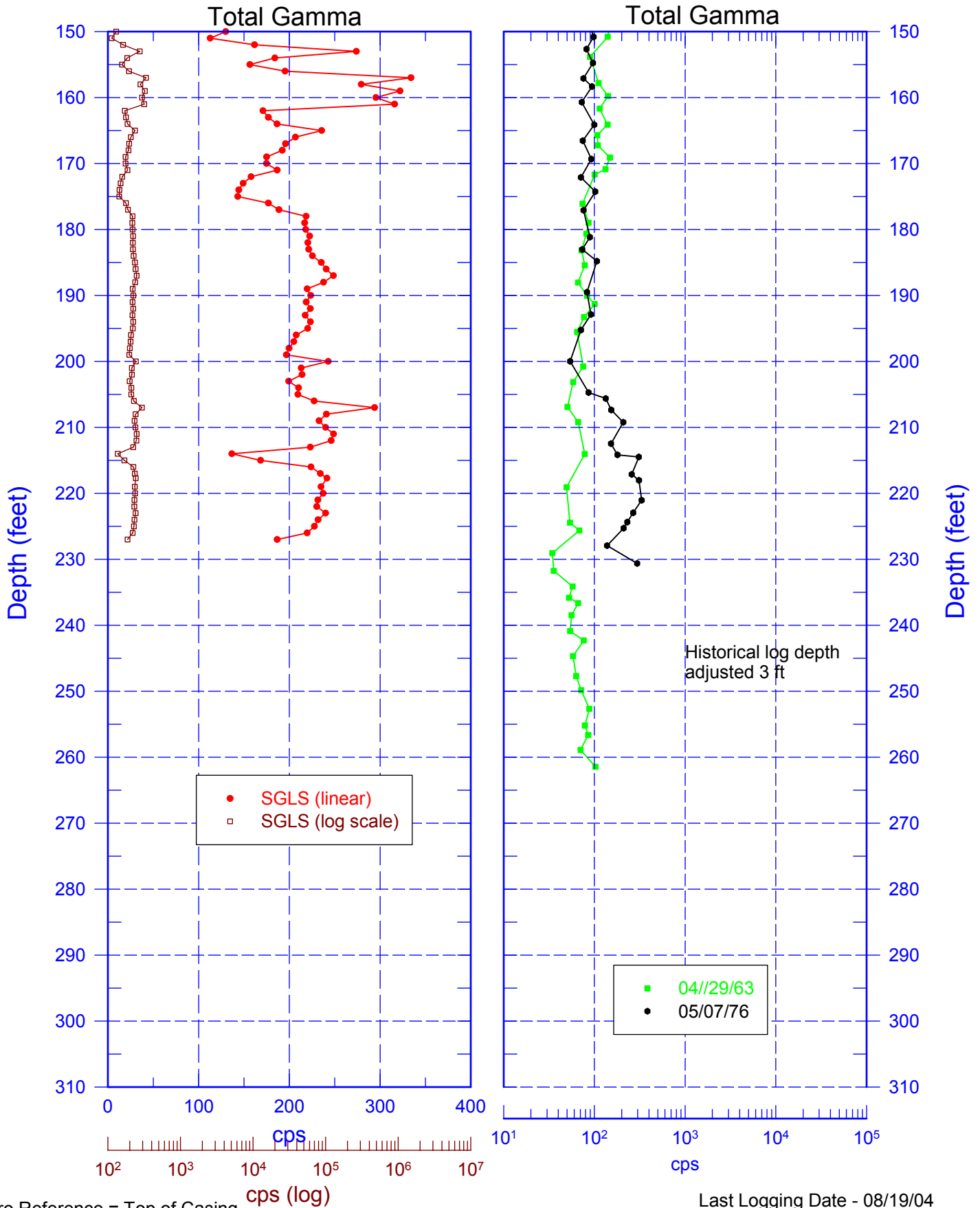


Zero Reference = Top of Casing

Last Logging Date - 08/19/04

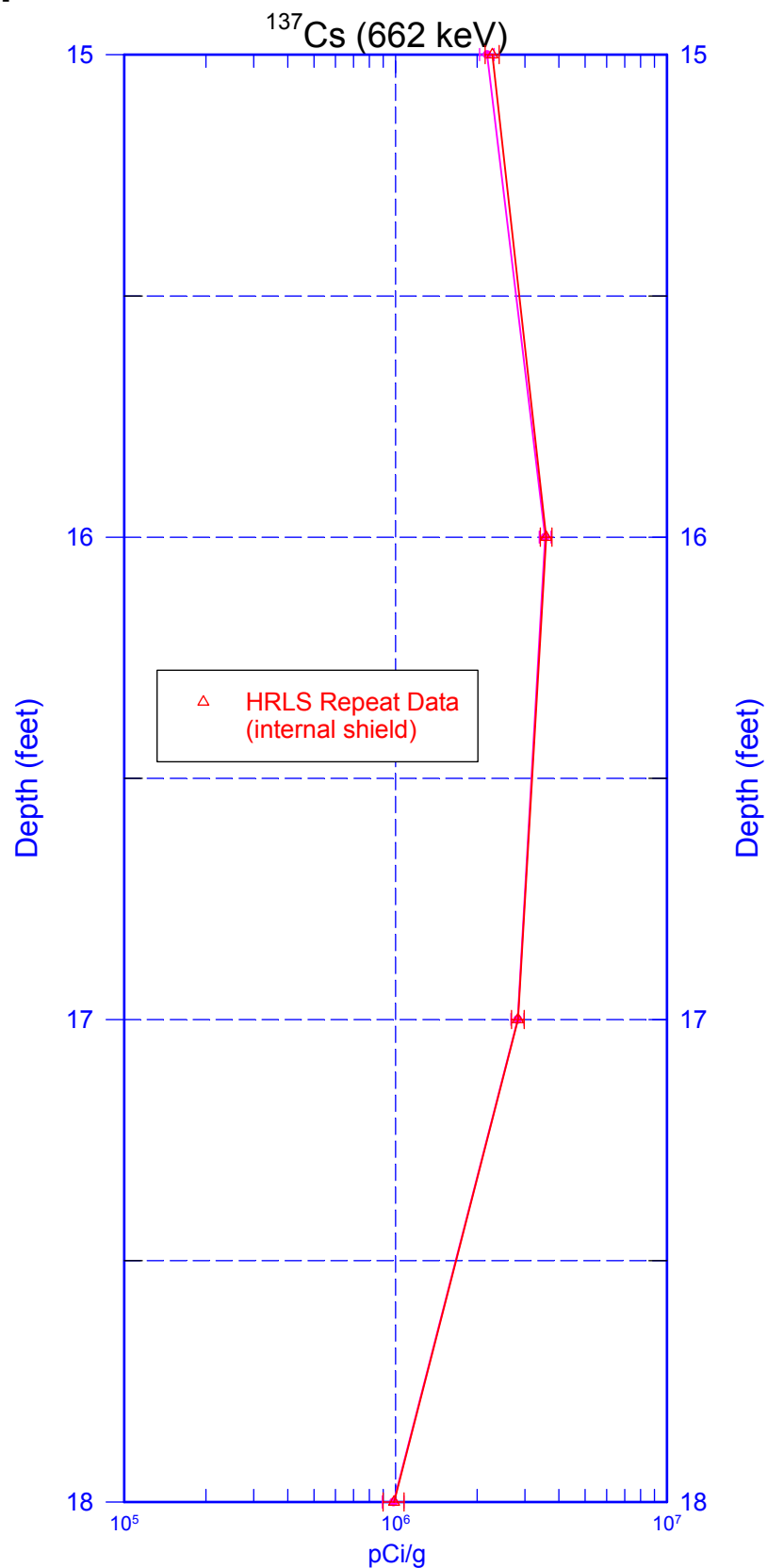
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Total Gamma



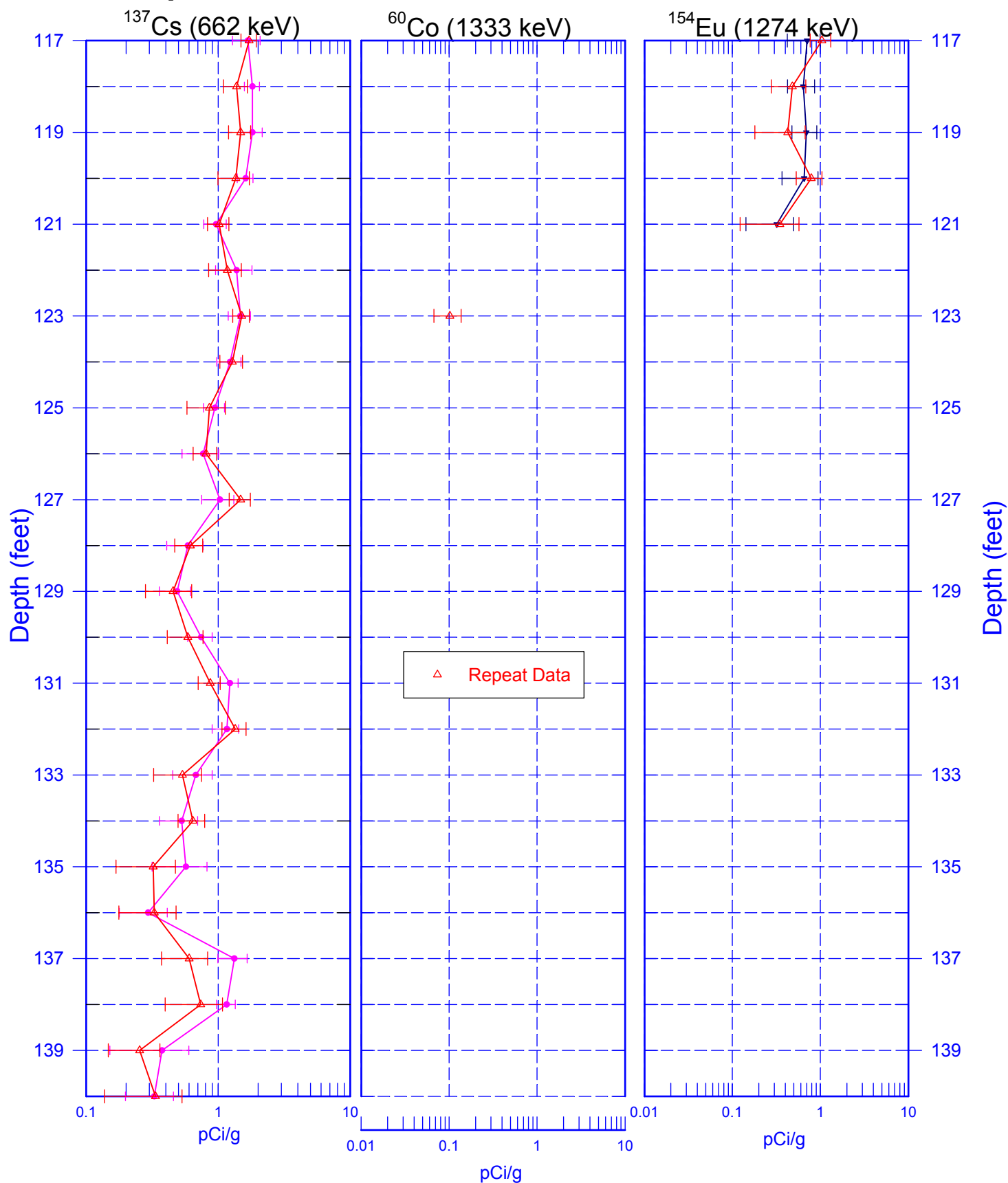
299-W14-03 (A7329)

Repeat Section of Man-Made Radionuclides



299-W14-03 (A7329)

Repeat Section of Man-Made Radionuclides



Zero Reference = Top of Casing

Last Log Date - 08/19/04